

friction at their interface produces waves which cause the fluctuations of temperature and wind speed. The drop in humidity is occasioned by the displacing of the cold air by warm.

All this is in accordance with the views of Bjerknes² on the passage of the "steering surface" (*surface directrice*) which occurs in the front of a cyclone.—C. L. M.

² Bjerknes, J.: Über die Fortbewegung der Konvergenz und Divergenzlinien. *Meteorologische Zeitschrift*, 1917, pp. 10-11.

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AMOUNT AND COMPOSITION OF RAIN FALLING AT ROTHAMSTED.

By E. J. RUSSELL and E. H. RICHARDS.

[Abstracted from *The Journal of Agricultural Science*, London, October, 1919, vol. 9, pp. 309-337.]

Agricultural chemists of the last generation expended a great deal of energy in investigating the problem of whether or not plants could assimilate free nitrogen from the air. An auxiliary problem concerned itself with the source of nitrate and ammonia: Whether they could be supplied in sufficient quantity by the air and rain, or whether artificial supply by fertilizers was necessary. In more recent years the investigation has been continued, not in its original form, but in its relation to atmospheric pollution. The authors of this article have thus investigated the rainfall for Rothamsted for the 10 years following 1905.

The rain water was first studied with respect to the content of ammoniacal nitrogen and then with respect to nitric nitrogen, and it was found that up to 1910 both forms of nitrogen varied in amount directly as the rainfall, the former in about twice as great amounts as the latter. But since 1910, the quantity of nitric nitrogen has appeared to have no simple relationship to the rainfall. The actual amount of ammoniacal nitrogen was about 2.64 pounds per acre, and its monthly fluctuations appear to follow the rainfall closely, being greatest between May and August and least between January and April.

The sources of ammonia are thought to be three, chiefly, the ocean, the soil, and pollution from cities. Since neither the first nor the last seem adequate to account for all the ammonia, the soil itself must generate an appreciable amount. This conclusion appears to be justified because of the direct relation existing between the ammonia content of the soil and biochemical activity. Moreover, the close relationship between ammoniacal and nitric nitrogen suggests either a common origin or the production of nitric compounds from ammonia.

The chlorine content of rain is such as to bring down 16 pounds per acre per year. While there is a close relation between chlorine content and rainfall, there is a decided increase in quantity in the winter months, which is attributed to the transportation of chlorine from the ocean by the gales prevalent during those months. Some of it, however, may come from fuel.

Both chlorine and nitric nitrogen have shown a steady increase from the first measurements in 1888 to the present time. The ammonia content has fallen off. The total of ammoniacal and nitric nitrogen, however, has remained about constant, indicating that perhaps the former source of ammonia is now producing nitric acid. Perhaps the modern gas ranges and grates have produced this effect.

It was found that 66.4 pounds of dissolved oxygen per acre was brought down by rain annually.

The difference of content of winter and summer rain, the former being rich in chlorine and low in nitrogen,

and the latter having the relation reversed, makes it seem that the formation of rain during the two seasons differs. Since the winter rain so closely resembles Atlantic rain, it is thought that summer rain may be caused by evaporation of water from the soil and condensation at higher altitudes than in the case of winter rain.—C. L. M.

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ATMOSPHERIC POLLUTION.

(Sixth Report of the Committee for the Investigation of Atmospheric Pollution, Meteorological Office, London, 1921.)

[Abstract of review by Alexander McAulie in *Science*, New York, Apr. 22, 1921, pp. 389-391.]

In a previous REVIEW¹ is an abstract of the Fourth Report of the Committee for the Investigation of Atmospheric Pollution containing a detailed analysis of the solids collected in the atmosphere of London, Newcastle, and Malvern, the two latter stations showing, respectively, the greatest and the least amounts of pollution.

In all, 29 gages are in operation, distributed as follows: Birmingham, 3; London, 8; Glasgow, 9; Southport, 2; and 1 each at Kingston, Malvern, Newcastle, Rochdale, Rothamsted, St. Helen's, and Sterling.

The following data are given in this report: (1) Monthly deposits for the two stations representing high and low deposits; (2) total solids deposited monthly at all stations; (3) monthly deposits for summer-half years, i. e., April to September, 1918 and 1919; (4) mean monthly deposits for winter-half years, i. e., October to March, 1918-19, and 1919-20; (5 and 6) classification of stations according to amounts of elements; (7 and 8) totals of classified stations for each element of pollution; (9) comparison of mean monthly deposit during summer and winter; (10) average deposit of each element for each month for two London and four Glasgow stations; also six summaries and analyses.

The table below (somewhat abridged) gives the mean monthly deposits at selected stations.

TABLE 1.—Mean monthly deposit in metric tons per square kilometer.

Meteorological office.....	8.43
Finsbury Park.....	10.78
Ravenscourt Park.....	14.09
Southwark Park.....	15.35
Hasketh Park.....	6.41
Woodvale Moss.....	5.34
Malvern.....	3.17
Bellahouston Park.....	8.87
Botanic Gardens.....	10.91
Queens Park.....	8.01
Richmond Park.....	12.15

As might be expected the greatest amount of tar deposit occurred in the winter months, when domestic fires are in constant operation. The results of the investigation also seem to indicate that wind plays an important part, high winds sweeping away much of the suspended matter, thus preventing it from being deposited near the source.

Automatic filters holding 24-hour disks were employed. From a large number of records made from these disks in London there appears to be a definite cycle during the 24 hours in the distribution of impurities. Thus from midnight to 6 a. m. the air is practically clear of impurity, very little being recorded except during fogs. At about 6 a. m. when fires are lit, there is an increase until 11 a. m. From 11 a. m. to 10 p. m. there is little variation. After the latter hour, however, there is a rapid decrease to midnight when the minimum period begins.

In considering the feasibility of utilizing standard rain gages in the measurement of solid deposits, the

¹ MONTHLY WEATHER REVIEW, November, 1919, 47: 806-807.

committee found it practically impossible to estimate accurately the quantity of tar and sulphates present; and these indicate the origin of the deposit. The difficulty experienced was the dissolution of the metal of which the rain gages is constructed.—H. L.

ENGINEERING APPLICATIONS OF STATISTICAL WEATHER DATA.

By REID DAVIES.

[Abstract of paper, "Some temperature probabilities for March," published in *The Heating and Ventilating Magazine*, New York, February, 1921, pp. 37-39.]

During the past 15 years *The Heating and Ventilating Magazine* has been publishing, monthly, charts showing the weather conditions in several of the larger cities in this country [cf. charts for December, 1920, *ibid.*, pp. 50-51]. These charts find their principal value in connection with analysis of heating-plant operation, coal consumption, etc. Obviously they are of little value in connection with the design of new installations because the weather conditions of a given month will never be exactly duplicated in any succeeding month. Of distinct value, however, from the design standpoint, would be knowledge of the maximum and minimum and average conditions over a period of years sufficiently long to make the figures reliable for inductive purposes.

A series of seven charts of curves is published each month for New York, Boston, and Chicago, showing for each day: The highest temperature for the entire period of observations, the highest mean temperature, the average maximum temperature, the average mean temperature, the average minimum temperature, the lowest mean temperature, and the lowest temperature ever reached.

While this discussion is confined to the curves for New York City, there is almost equal application to the charts

for the other cities mentioned. An engineer, figuring on the cost of operating a heating plant during March, can see from the chart that the daily average mean temperatures remain well below 50° throughout the month, and average for the entire month 38°. This indicates that during March sufficient coal will have to be consumed to provide for a continuous heating of the outside air from 38° to the desired inside temperature. The curves also show the possibility that on some days during March, no heating will be required, as well as equal possibility that on some days considerably more heating will be required, with corresponding fuel consumption.

Obviously the month of March does not show the maximum heating requirement of a system, as December, January, and February temperatures will fall below those of March, but where an installation comprises several heating units, the March chart will indicate how many are likely to be required in operation during that month. The chart is more reliable for a period of years than for any one year, and as a heating installation is made for use over a period of years, the use of the chart will indicate probable operating characteristics of the installation during its period of service.

Temperature records for March.

	New York.	Boston.	Chicago.
	° F.	° F.	° F.
Record high temperature.....	78	78	80
Highest daily mean temperature.....	66	62	70
Average maximum temperature.....	45	44	42
Average mean temperature.....	38	37	35
Average minimum temperature.....	30	30	29
Lowest daily mean temperature.....	9	—1	1
Record low temperature.....	3	—8	—12

—H. L.

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C. FITZHUGH TALMAN, Professor in Charge of Library.

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